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A New Species of Hanging-Parrot (Aves: Psittacidae: *Loriculus*) from Camiguin Island, Philippines

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Abstract

A new species of Hanging-Parrot or Colasisi, *Loriculus*, is described from a series of 23 specimens (19 males, 4 females) collected in the 1960s on Camiguin Island, Camiguin Province, Philippines, at elevations between 300 and 1350 m. The new species lacks sexual dimorphism in plumage coloration, which distinguishes it from all other members of the *L. philippensis* group and all other *Loriculus*. The overall color pattern of the new species appears most like females of *L. p. worcesteri* and *L. p. apicalis* but differs in plumage characteristics (the width and extension of the orange-scarlet crown patch, the amount and intensity of blue in the face and thighs, and the intensity of the blue in the tail above inner edges and the tail below). In addition, males of the new species are larger than males of nearby populations of *L. philippensis*, having significantly longer tails and wing chords. Nothing is known about the habits of the new species; however, the small size of the island of Camiguin, coupled with extensive deforestation, makes the status of the new species a significant conservation concern.

Introduction

The Philippine Hanging-Parrot or Colasisi (*Loriculus philippensis*) has ten described subspecies distributed throughout the islands of the Philippines (Dickinson et al., 1991; Collar, 1997; Juniper & Parr, 1998; Kennedy et al., 2000). The subspecies *L. p. apicalis* has been reported to occur on the islands of Bazol, Balut, Camiguin, Dinagat, Mindanao, and Siargao (Fig. 1). However, Austin Rand, a former Field Museum curator and Philippine expert (e.g., Rand & Rabor 1960, 1969), had penciled the notation "subsp. nov" on the tag of a specimen from Camiguin in the FMNH collection. He never published a description. Here, we quantitatively evaluate the external morphology and compare the plumage color of specimens referred to *L. p. apicalis* from Camiguin with *L. p. apicalis* from Mindanao and specimens of other subspecies of *L. philippensis*. Our results demonstrate that the Camiguin population of *L. p. apicalis* is separable from all other populations of *L. philippensis* in plumage. It is further separable from all neighboring populations in body size. We argue that these differences warrant designating this population as a distinct species and not a subspecies of *L. philippensis*. Similar arguments have been made in separating *L. bonapartei* of the Sulu Archipelago from the *L. philippensis* complex (Juniper & Parr 1998). We present a formal

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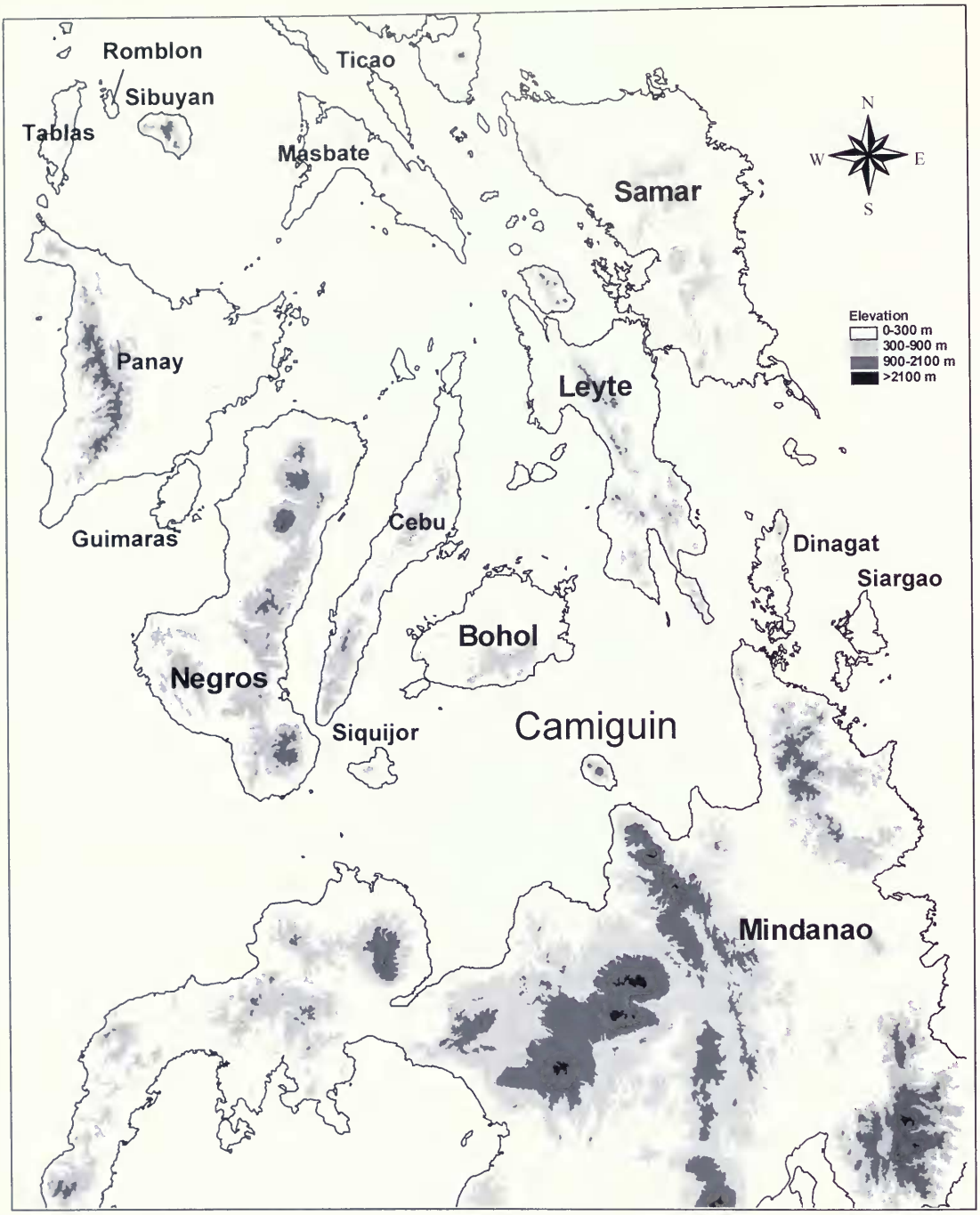

FIG. 1. Map of the central and southern Philippines showing the locations of islands referred to in the text.

description of the new taxon based on plumage and morphology of adult males.

Methods

All qualitative color comparisons were made under natural light. Color names follow Smithe (1975), and each color name (capitalized) is followed by its number in parentheses. J.F.D. measured wing chord, tarsus length, tail length (from point of insertion of central rectrices to tip of longest rectrix), culmen length, bill length (from anterior edge of nostril), bill height (at anterior edge of nostril), bill width (at anterior edge of nostril), and gape width with calipers to the nearest 0.05 mm. Specimens were measured randomly to avoid any investigator bias.

All statistical analyses were carried out using the program Statistica (Statsoft Inc. 1995). Mensural data were tested for normality using Kolmogorov–Smirnov tests and Lilliefors probabilities prior to all the analyses. Mensural differences between males and females within each study population were evaluated using one-way analyses of variance (ANOVAs). We used both univariate (one-way ANOVAs and Bonferroni post hoc tests) and multivariate analysis (principal components and discriminant function) on log-transformed data to test for mensural differences between specimens from Camiguin and those from neighboring populations of *L. philippensis*. Multivariate analyses were used to reduce the dimensionality of data and facilitate the analysis of morphology in two or three dimensions (Pimentel, 1979); we used the varimax raw method to rotate the three components that are reported in the principal components analysis in order to improve interpretability of the resulting patterns. Collecting localities are described by Heaney and Tabaranza (2006a).

Loriculus camiguinensis, new species

Camiguin Hanging-Parrot

Holotype—Field Museum of Natural History No. 284389, adult male from Kasangsangan, Municipality of Catarman, Camiguin Province, Camiguin Island, Philippines, elevation between 1000 and 2000 ft (300–600 m; approx. 9°11′N, 124°40′E; see Heaney & Tabaranza, 2006a, for more explanation of this and other collecting localities on Camiguin Island), 18 June 1968, collected by D. S. Rabor and W. Sanguila.

Diagnosis—A *Loriculus* hanging-parrot with characteristics of the *philippensis* group (see Front Plate). In contrast to other members of this group, *L. camiguinensis* is characterized by a lack of sexual dimorphism in plumage coloration. The overall color pattern of *L. camiguinensis* is most like females of *L. p. worcesteri* from Bohol, Leyte, and Samar and *L. p. apicalis* from Mindanao but differs as follows: (1) the scarlet of the crown of *L. camiguinensis* does not extend as far onto the bright olive green nape as it does in both males and females of *L. p. apicalis* and *L. p. worcesteri*; this pattern differs from that of *chrysonotus*, *siquijorensis*, *regulus*, *bournsi*, *mindorensis*, and *philippensis*, in which the scarlet crown is highly reduced. (2) The width of the scarlet crown in *L. camiguinensis* narrows at the rear edge instead of being rounded as in all other populations. (3) The scarlet (sometimes orange) throat patch that is typical of males in *L. philippensis* is lacking in *L. camiguinensis*; five of the Camiguin males had data on gonadal development, reporting enlarged or slightly enlarged testicles, which gives an indication of their adult condition. (4) The face of *L. camiguinensis* is extensively turquoise blue and differs from that of females of *L. philippensis* subspecies in that the blue of the face is darker and more extensive, extending over the eye and onto the throat. (5) The turquoise blue in the thighs of *L. camiguinensis* is darker than that of females of *L. philippensis* populations. (6) The blue in the inner edges of the rectrices above and throughout below is darker in *L. camiguinensis*. (7) Mean wing chord and tail length of males and tail length of females of *L. camiguinensis* are significantly longer than those of nearby *L. philippensis* subspecies (Tables 1 and 2). (8) The overall green plumage is a darker shade with less of a yellowish tinge, especially on the back.

Description of Holotype—General plumage Parrot Green (160) with slightly orange tinge in the upperparts, more yellowish tinge on underparts; forehead and forepart of crown Scarlet (14) fading to orange at rear-edge; thin Orange Yellow (18) band on nape; lores, chin, cheek, and throat closest to Turquoise Blue (65); rump and upper tail-coverts scarlet; Turquoise Green (64) markings on the sides of the rump; thighs slightly paler Turquoise Blue; rectrices Emerald Dark Green (262) above with dark Cerulean Blue (67)

tinges on inner edges of all but central rectrices; rectrices dark Cerulean Blue below; flight feathers black above with Emerald Dark Green outer edges, flight feathers black below with inner edges with extensive Cerulean Blue; greater underwing-coverts Cerulean Blue and lesser underwing-coverts closest to Spectrum Green (62). Soft part colors of dried specimen: upper mandible closest to Spectrum Orange (17) at base grading to yellow with Gray Horn (91) at tip and along tomia; lower mandible with similar pattern, but orange at the base; cere Grayish-Horn; feet and tarsi, yellow-horn.

Measurements of Holotype (mm)—Wing (99.8), tarsus (11.7), tail (49.5), culmen (18.0), bill length (15.0), bill height (11.1), bill width (6.4), gape width (8.2).

Distribution—Loriculus camiguinensis is known only from the forests of Camiguin Island. Specimens have been collected between 1000 and 4500 ft (300–1350 m) in the municipalities of Catarman and Mahinog (Balete et al., 2006; Heaney & Tabaranza, 2006a).

Etymology—We name this species after the Philippine Island of Camiguin, to which this species appears to be endemic.

Specimens Examined—We examined the following specimens from Field Museum of Natural History (FMNH) and Delaware Museum of Natural History (DMNH):

L. camiguinensis (Camiguin Island) (19 males, 4 females, all known specimens of this new taxon): Camiguin Province: Catarman Municipality; Kasangsangan (males: FMNH holotype, FMNH 284391, 284392, 284393; DMNH 19950, 19958, 19960, 19961, 19962: females FMNH 284390; DMNH 19959); Camiguin Province: Catarman Municipality; Catarman Mountain (male: DMNH 19949); Camiguin Province: Mahinog Municipality; Matugnao, Mt. Timpoong (males: FMNH 286742, 286743, 286744, 286745; DMNH 19951, 19952, 19953, 19954, 19965; females: FMNH 286746, 286747).

L. p. apicalis (Mindanao Island) (19 males, 5 females): North Cotabato Province: Mt. Apo, Todaya (male: FMNH 184090); North Cotabato Province: Mt. Apo, Galog (male: DMNH 36227); Agusan del Norte: Mt. Hilong-Hilong, Lewed (male: FMNH 275003); Misamis Occidental: Zamboanga Peninsula, Mt. Malindang, Gandwan (males: FMNH 227136, 227138, 227139; female: FMNH 227137); Misamis Occidental: Zamboanga Peninsula, Mt. Malindang, Masawan (males: FMNH 227134, 227135); Davao Oriental Province; Mati: Mt. Mayo, Limot (male: FMNH 277864); Misamis Oriental Province: Manticao: Tuod, Camp Dundue (male: FMNH 283788; female FMNH 283787); Misamis Oriental Province: Opol: Malubato (male: FMNH 283785); South Cotabato: Tupi: Mt. Matutum (male: FMNH 279330); Bukidnon Province: Malaybalay, Mt. Katanglad (male: FMNH 262475, 262476; female: FMNH 262474); Bukidnon Province: Lantapan: Kotoon, Mt. Katanglad SE slope (male: DMNH 2983); Lanao Norte Province: Iligan City, Mainit, Mahayahay (female: FMNH 283786); Surigao del Sur Province: Car-Can-Mad-Lan area (female: FMNH 275002); Zamboanga del Sur Province: Zamboanga (male: DMNH 36993); Davao Oriental Province: Sigaboy (males: DMNH 36224, 36226); Davao del Sur Province: Padada (male: DMNH 36233).

L. p. worcesteri (11 males, 8 females): Bohol Island: Bohol Province: Sierra Bullones (males: FMNH 223025, 223026, 223029, 223030, 223034, 223036, 223037; females: FMNH 223027, 223327, 223028, 223033, 223035, 223039); Leyte Island: Leyte Province: Burauen, Buri, Ma-Alngon (male: FMNH 276302; female: FMNH 276300); Leyte Province: Burauen, Buri, Mt. Lobi range, Tambis (male: FMNH 276299; female: FMNH 276298); Samar Province: Mt. Capotoan (male: FMNH 247411); Western Samar Province: Matuguinao (male: FMNH 247410).

L. p. regulus (Negros Island) (5 males, 4 females): Negros Oriental Province: Bayawan, Basay (male: FMNH 257121); Negros Oriental Province: Santa Catalina, Inubungan (male: FMNH 219314; male: FMNH 188579); Negros Oriental Province: Sicopon River (male: FMNH 185483); Negros Oriental Province: Amio (males: FMNH 188545, 188548; females: FMNH 188544, 188553); Negros Oriental Province: Pamo-at (male: FMNH 188550).

L. p. chrysonotus (captive specimen, presumably from Cebu Island) (1 male): Cebu Province: Exact locality unknown (FMNH 252666).

L. p. siquijorensis (Siquijor Island) (1 male): Siquijor Province: San Juan: Tag-ibo (FMNH 222741).

L. p. bourusi (Sibuyan Island) (1 male, 1 female): Romblon Province: Goangan, 3 km SE Magdiwang (male: FMNH 358288); Romblon Province: Exact locality unknown (female: FMNH 11081).

L. p. mindorensis (Mindoro Island) (1 male, 1 female): Oriental Mindoro Province: Calapan (male: FMNH 19927); Occidental Mind-

TABLE 1. Ranges, means (±SE), and sample sizes of selected measurements (mm) of *L. camiguinensis* and neighboring populations of *L. philippensis*. One–way analysis of variance tests comparing differences due to sex within each population. *Significant at $P<0.05$, but non-significant when P-values were adjusted for the number of simultaneous tests, 0.05/16=0.003.

Characters	*L. camiguinensis*		*L. p. apicalis*		*L. p. worcesteri*		*L. p. regulus*	
	♂	♀	♂	♀	♂	♀	♂	♀
Wing chord	93.1–100.0 97.6 ± 0.5 *n* = 18	95.7–103.0 99.3 ± 1.5 *n* = 4	87.1–98.3 91.8 ± 0.6 *n* = 19	90.1–94.1 92.6 ± 0.9 *n* = 4	88.6–93.8 91.7 ± 0.5 *n* = 11	85.2–97.0 92.4 ± 1.2 *n* = 8	90.5–94.2 92.1 ± 0.8 *n* = 4	91.2–93.2 92.4 ± 0.6 *n* = 3
Tarsus length	10.4–12.9 11.5 ± 0.1 *n* = 18	11.3–12.4 11.9 ± 0.3 *n* = 3	9.0–11.5 10.3 ± 0.2 *n* = 19	9.5–11.0 10.1 ± 0.3 *n* = 4	9.5–11.3 10.3 ± 0.2 *n* = 11	10.1–11.3 10.8 ± 0.1 *n* = 8	9.2–11.0 10.2 ± 0.4 *n* = 5	10.8–11.7 11.2 ± 0.2 *n* = 4
Tail length	42.6–50.5 47.8 ± 0.5 *n* = 17	47.5–53.6 50.3 ± 1.4* *n* = 4	38.1–45.8 42.9 ± 0.5 *n* = 19	42.4–47.4 44.4 ± 1.1 *n* = 4	41.8–46.1 44.4 ± 0.5 *n* = 11	38.2–47.1 44.6 ± 1.0 *n* = 8	42.7–43.7 43.2 ± 0.2 *n* = 5	43.2–48.6 44.8 ± 1.3 *n* = 4
Culmen length	17.5–19.2 18.2 ± 0.1 *n* = 18	17.1–19.0 17.8 ± 0.4 *n* = 4	16.2–18.2 17.4 ± 0.1 *n* = 19	17.2–17.6 17.4 ± 0.1 *n* = 4	16.0–19.2 17.7 ± 0.3 *n* = 11	16.4–17.8 17.1 ± 0.2 *n* = 8	16.5–19.0 17.8 ± 0.4 *n* = 5	16.4–17.2 16.8 ± 0.2 *n* = 4
Bill length	13.6–15.0 14.3 ± 0.1* *n* = 18	12.4–14.8 13.5 ± 0.5 *n* = 4	12.5–14.3 13.5 ± 0.1 *n* = 19	12.9–13.2 13.0 ± 0.1 *n* = 4	11.7–14.6 13.7 ± 0.3 *n* = 11	12.4–13.2 13.0 ± 0.1 *n* = 8	13.1–14.5 13.7 ± 0.3 *n* = 5	12.0–13.4 12.6 ± 0.3 *n* = 4
Bill height	9.2–11.1 10.3 ± 0.2 *n* = 14	9.3–10.8 10.1 ± 0.3 *n* = 4	8.1–11.0 9.7 ± 0.2 *n* = 15	9.5–10.8 10.0 ± 0.3 *n* = 4	9.4–11.4 10.2 ± 0.2* *n* = 10	9.3–9.9 9.6 ± 0.1 *n* = 6	9.0–9.6 9.3 ± 0.1* *n* = 5	8.6–9.4 9.0 ± 0.2 *n* = 4
Bill width	6.1–7.5 6.6 ± 0.1 *n* = 18	6.0–6.8 6.4 ± 0.2 *n* = 4	5.4–7.2 6.0 ± 0.1 *n* = 19	5.8–6.2 6.1 ± 0.1 *n* = 4	5.5–7.0 6.3 ± 0.2 *n* = 10	5.8–6.2 6.0 ± 0.1 *n* = 7	5.5–6.3 6.0 ± 0.1 *n* = 5	5.3–6.4 5.8 ± 0.2 *n* = 4
Gape width	7.2–8.8 7.9 ± 0.1 *n* = 18	7.3–8.0 7.6 ± 0.2 *n* = 4	6.1–7.9 7.2 ± 0.1 *n* = 19	7.2–8.0 7.4 ±0.2 *n* = 4	6.7–8.1 7.3 ± 0.1 *n* = 10	6.8–7.5 7.1 ± 0.1 *n* = 7	7.2–7.6 7.4 ± 0.1 *n* = 5	7.2–7.8 7.6 ± 0.1 *n* = 4

TABLE 2. Univariate statistical comparisons between *L. camiguinensis* and adjacent populations of *L. philippensis*. Populations (1 = *L. camiguinensis*; 2 = *L. p. apicalis*; 3 = *L. p. worcesteri*; and 4 = *L. p. regulus*) are ordered based on their mean variation, from smallest to largest (left to right). * *F* values significantly different at $P < 0.05$ (one-way analysis of variance and Bonferroni post-hoc test). For each morphometric variable, populations united by the underlines showed non-significant differences.

Morphometric variables	*F*	Populations			
Wing chord	30.5*	2	3	4	1
Tail length	23.1*	2	4	3	1
Tarsus length	14.8*	2	3	4	1
Gape width	9.8*	2	3	4	1
Bill length	3.7*	2	4	3	1
Total culmen	3.5*	2	3	4	1
Bill height	4.0*	4	2	3	1
Bill width	5.2*	2	4	3	1

oro Province: Abra de Ilog (female: FMNH 210845).

L. p. philippensis (Luzon Island) (1 male, 1 female): Bataan Province: Mariveles (male: FMNH 73966); Cagayan Province: Sierra Madre, Mt. Cagua (female: FMNH 258827).

Morphometric Differences—One-way ANOVAs on all known *L. camiguinensis* specimens and specimens in the FMNH collection from neighboring islands showed that certain variables differed between sexes in some of the study populations, but no consistent pattern was found (Table 1). Because of the small sample of females available for this study, we include only males in the analyses.

Results of the one-way ANOVAs (effect = population) and Bonferroni post hoc tests showed that males of *L. camiguinensis* are morphologically distinct from males of other *L. philippensis* populations. Wing chord, tail length, and tarsus length were significantly longer in *L. camiguinensis* males than in the other populations (Table 2).

Principal components analysis for males from all populations resulted in three rotated (varimax raw) factors with Eigenvalues close to or greater than 1.0, which together explained 73.2% of the total variance (Table 3). Axes defined by the first and third component (particularly the third) demonstrate separation of *L. camiguinensis* from the other populations (Fig. 2). The first component explained 45.2% of the total variance and had high positive correlations with bill width, bill height, and gape width (0.80, 0.77, and 0.71, respectively). The second component explained 16.8% of the total variance and had high positive correlation with bill length and culmen length (0.92 and 0.88, respectively). The third component explained a further 11.2% of the variance and had the highest positive correlation values for tail length and wing chord (0.94 and 0.84, respectively). It was this latter axis that differentiates *L. camiguinensis* from the other populations.

TABLE 3. Fraction of total variance explained by each of the first three components of the principal components analyses. The three components were rotated (see Methods).

Morphometric variables	PCI	PCII	PCIII
Wing chord	0.25	0.29	0.84
Tarsus length	0.29	0.31	0.40
Tail length	0.16	0.04	0.94
Total culmen	0.14	0.88	0.18
Bill length	0.05	0.92	0.09
Bill height	0.77	0.15	0.17
Bill width	0.80	−0.04	0.21
Gap width	0.71	0.33	0.35
Eigenvalue	*3.62*	*1.34*	*0.90*
Explained variance (%)	*45.21*	*16.79*	*11.21*

A discriminant function analysis using these morphometric variables was also significant ($P < 0.001$) and correctly classified 88% of the cases (plot not shown). The standardized coefficients of the discriminant function separating males of *L. camiguinensis* from those of other *L. philippensis* populations weighted tarsus length and wing chord heavily (0.80 and 0.80, respectively), followed by tail length (0.46) and bill length (0.40), with all the other variables having coefficients under 0.32.

A Question of Correctly Sexed Specimens—Unpublished concern has been expressed regarding the ability of Rabor and his field assistants to accurately determine the sex of specimens. This possibility presents a serious issue with respect to interpreting the data at hand. In an attempt to verify sexing, we tried unsuccessfully to amplify DNA from toe pads of some specimens using commercially available primers for sex-linked DNA. However, for the following reasons, we remain convinced that there is good reason to believe that the issue of sexing does not overshadow the validity of this taxon. It is our experience that mis-sexing

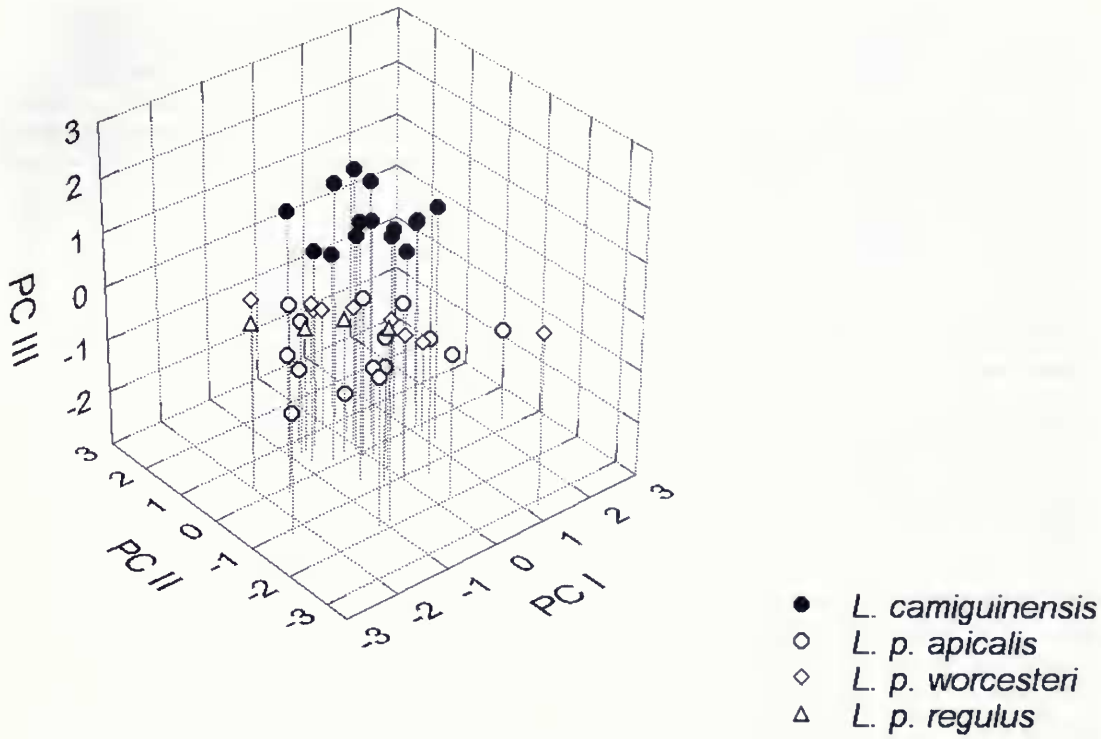

FIG. 2. Results of the Principal Components Analysis of morphological data from populations of Philippine *Loriculus*, on the first three axes; see text for details.

most commonly involves undeveloped gonads, and there are clearly labeled tags indicating that the gonads of some specimens were developed. If mistakes were made, the plumage characters of the specimens described above would logically argue that all males were misidentified as females. Again, this seems highly unlikely given the number of males (19). Furthermore, it seems highly unlikely that a series of 23 randomly collected parrots would all have been females. Certainly, there is nothing like this in other series of *Loriculus* collected by Rabor in other parts of the Philippines. Thus, while we cannot say that all specimens are unequivocally identified to sex correctly, we feel that adults of both males and females are included in these series.

Discussion

Our results demonstrate that *L. camiguinensis* is diagnosable from populations of *L. philippensis* in plumage. It also differs in size from all neighboring populations. We were able to make direct comparisons with specimens of all subspecies except *L. p. dohertyi* (Basilan). It is possible that *L. camiguinensis* is more closely related to some parts of the *L. philippensis* group than others, which would make *L. philippensis* paraphyletic (Funk & Omland 2003). Despite this possible relationship to the widespread *L. philippensis* group, we believe *L. camiguinensis* sufficiently differentiated to be beyond concerns expressed about recognizing new species based on minor morphologic differences (e.g., Collar et al., 1999). Based on geographic distance and the overall pattern of plumage coloration, *L. camiguinensis* most closely resembles populations of *L. p. apicalis* and *L. p. worcesteri*, but no phylogenetic analyses exist yet for these taxa. The comparatively dull plumage of the male of *L. camiguinensis* is consistent with the documented tendency for some insular bird populations to lose bright plumage, leading to a lack of sexual dichromatism (see references in Peterson, 1996); *L. camiguinensis* is the only member of the genus without sexual dichromatism in plumage.

The recognition of this distinctive taxon coincides with recent surveys of the small mammal fauna of Camiguin Island that have discovered two new species of rodents (Riekart et al., 2002; Heaney et al., 2006). Camiguin is believed to be the smallest Philippine island to harbor endemic species of birds and mammals (Heaney & Tabaranza, 1997, 2006a). The island has been continuously isolated from its large southern neighbor, Mindanao, even during periods of low sea level during the "ice ages" of the Pleistocene, when sea levels dropped to 120 m below present levels (Heaney, 1986, 1991a, 1991b; Fairbanks, 1989; Heaney and Tabaranza, 1997, 2005b; Heaney and Regalado, 1998; Hanebuth et al., 2000), and this may have played a role in the differentiation of Camiguin's fauna from that of Mindanao (Steppan et al., 2003).

The value of museum collections is well illustrated with this description. These collections were essential in the recognition and documentation of *L. camiguinensis*. Had there not been a series of specimens available for study, we would have likely dismissed differences in the new taxon as possibly aberrant or immature plumage or an error in sexing of a specimen (a female incorrectly identified as a male; see above). However, the presence of a series of specimens from different localities (with data on gonadal development) has allowed us to compile meaningful data sets on morphological variation and assess within-population variation in color.

This new species also illustrates the need for additional taxonomic and systematic research on the *Loriculus* hanging-parrots to understand the evolutionary patterns in the group and to evaluate the possibility that some of the other allopatric forms of *L. philippensis* may also deserve species status. The issue of assessing the taxonomic status of allopatric populations in the Philippines has long been recognized as a challenge for conservationists (Collar et al., 1999; Peterson et al., 2000). To date, little attention has been given to the conservation plight of *Loriculus* parrots. For instance, none was included by Collar et al. (1999) in their list of threatened Philippine bird species. This lack of attention can be directly correlated with the designation of *L. philippensis* as a polytypic species. The plight of these populations is cause for concern, as *Loriculus p. chrysonotus* from the island of Cebu is believed to be extinct (Forshaw, 1989; Mallari et al., 2001) and another form, *L. p. siquijorensis*, may be extinct as well (Forshaw, 1989; Kennedy et al., 2000). The combined populations of Mindoro, Sibuyan, Negros, Panay, Tablas, Romblon, Masbate, Ticao, Guimaras, and Basilan (including *mindorensis*, *bournsi*, *regulus*, and *dohertyi*) may total no more than 5000 individuals (Juniper & Parr, 1998). The current population size of *L. camiguinensis* is not known (but see Heaney and Tabaranza, 2006a, for an assessment of remaining habitat on the island). Without field data on its status, we defer from suggesting how this species should be characterized under international threat criteria (IUCN Species Survival Commission, 1994). However, because Camiguin is a small island that has experienced extensive deforestation, the conservation status of this newly described species clearly requires assessment. Field study is needed to establish the population size and requirements as a prerequisite for conservation planning and action.

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